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The Control of Rinderpest with Special Reference to Goat-Adapted Virus as a Vaccine

BY

S. D. Achar, G.B.V.C., P.G. (Punjab)
Superintendent

AND

G. N. Srikantiah, G.M.V.C.
Veterinary Inspector, Mysore Serum Institute, Bangalore

The control of Rinderpest, that most contagious and fatal of bovine diseases, has for a long time been a very serious and urgent problem before experts in African and Asiatic countries where it commonly occurs and takes a heavy annual toll.

From time to time, various methods for conferring protection to susceptible animals against the disease have been recommended and practised, chief among which are :—

1. *Secretions of affected animals.*—Discharges from the mouth, nose and eyes of affected animals were inoculated subcutaneously with a view to giving a mild infection to healthy cattle, recovery from which should confer the desired immunity.

2. *Bile from affected animals.*—For long the practice of using the bile collected from animals which succumb to the disease was in

vogue in parts of Africa. Rogers tried this method in India and found it effective only in the case of plains cattle.

3. *Bile followed later by a reinforcing dose of virulent blood.*—Kohlstock and others introduced this method with a view to conferring a more solid and lasting immunity.

4. *Serum-alone method of Inoculation.*—For the first time in 1893, the protective value of serum from immunized animals was discovered and demonstrated. The protection conferred by the serum was however found to be of a very short duration. Although very valuable on the scene of outbreak to check the spread of disease and to give immediate immunity, it failed to confer lasting immunity. This led to an attempt to mix the serum-inoculated animals with the affected so as to secure an active and lasting immunity by getting a mild infection.

In India, until very recently, the serum-alone method of inoculation was being practised on a large scale. As many as 3,92,429 inoculations were done with this method in Mysore during a period of 11 years (from 1921 to 1932). From a study of the statements showing the number of inoculations and the results, it is seen that though a large number of animals was inoculated by the serum-alone method there was no reduction either in the number of outbreaks or mortality from Rinderpest.

5. *Serum-simultaneous method of Inoculation.*—The duration of protection conferred by the serum-alone method of inoculation being very short, Kolle and Turner, workingalong lines recommended by Kohlstock of treatment with bile followed by virulent blood, tried virulent blood and anti-serum simultaneously for effecting a lasting immunity. This proved successful and the serum-virus simultaneous method of inoculation was introduced by these two workers in 1897.

Although generally harmless, this method is opened to the following objections:

(*a*) The method is tedious as it involves two inoculations,

(*b*) It is costly as even in cases of the ordinary plains animals the cost will be over a rupee per head, and over four times as much to inoculate hill cattle and cattle of foreign breeds, and

(c) There is the possibility of introducing protozoa such as Piroplasma, Tryponosomes, Theileriæ with the Virus of Bovine origin.

Dr. J. T. Edwards worked on this subject in the Imperial Institute of Veterinary Research, Muktesar, and introduced this method in India on a large scale. Major R. W. Simpson, the then Superintendent, Civil Veterinary Department in Mysore, tried an experiment on 402 animals with very good results in the Mysore Palace Dairy Farm, at Rayanakere, and in Hassan District, in 1921-22. For various reasons this method could not be extended generally throughout the State till the year 1925-26.

The campaign of serum-simultaneous method of inoculation was however started in Mysore on an extensive scale by Major R. W. Simpson during September 1925. From that year onwards the serum-alone method of inoculation was gradually reduced whereas the serum-virus-simultaneous method of inoculation was increased to a great extent. During the seven years, 1925-26 to 1930-31, the number of animals inoculated according to this method was 7,12,338. The protective value of this method may be gauged by noting the year to year reduction in mortality by Rinderpest among the cattle of the State, the mortality being 1,201 during the year 1931-32 as against 34,228 during the year 1925-26.

6. *Spleen Vaccine.*—The earliest attempt at preparing glandular vaccine may be traced to Japanese workers in the year 1918. They used spleen and lymphatic glands of the affected animals for this purpose and claimed that the vaccine would keep for $3\frac{1}{2}$ years. Boynton tried with liver, spleen, lymphatic glands and muscles removed from the affected animals at the height of reaction. The methods that were adopted by Boynton were improved upon by Kelser and his co-workers who concluded that the vaccine obtained from the spleen had a better immunizing value than that from the other organs and that the vaccine would keep for one year only. In Japan, China and Philippine Islands the spleen vaccine is being used extensively with good results. But the duration of immunity produced by this method is not yet definitely known.

7. *Serum and Virus Production in Mysore.*—With the extension of the serum-virus-simultaneous method of inoculation all over the

State the need for large quantities of fresh virus became so urgent that a virus depot had to be started in the year 1925 at Bangalore, for the production and supply of Rinderpest virus. In order to meet promptly and economically the enormous and growing demands for anti-Rinderpest serum the Government of Mysore converted the virus depot, during 1927, into Serum Institute, where anti-Rinderpest serum as well as Rinderpest virus began to be produced on a sufficiently large scale to cope with the demands from both within and outside the State. Later, the Institute was enlarged and strengthened to such an extent that sera and vaccines against several other diseases of all kinds of live-stock could be prepared and supplied to the veterinary departments in and outside the State.

8. *Goat-adapted Virus.*—The next and the latest step towards the control of Rinderpest is the use of " Goat-adapted Rinderpest Virus " as a single vaccine. Koch while experimenting on Rinderpest in South Africa, in 1897 was the first to try passage of bovine virus in goats and to find out that the virus got attenuated for cattle by such means. Dr. Edwards conducted several further and original experiments in this direction in the Imperial Institute of Veterinary Research, Muktesar, and confirmed that by passing bovine virus through goats it could be altered to such an extent as to set up a reaction which approximates, more or less, to that caused during immunization by the serum-simultaneous method of inoculation. With a view to study the practicability of substituting goat virus inoculation for the present serum-simultaneous method, several investigations in the shape of laboratory experiments and field tests were conducted by the staff of the Serum Institute and the Civil Veterinary Department in Mysore since the early part of 1931. And as a result, it has been found that " fixed goat virus " produced in the Institute can be safely used for protecting cattle against Rinderpest in place of serum-simultaneous method of inoculation and that goat virus inoculation confers a lasting immunity from the disease.

Since about the same time much valuable work besides several inoculations has been done with goat virus in the Central Province successfully and these have been described ably in a series of articles by Major Sterling. In certain other parts of India such as Bengal, Assam, Bihar, Orissa and Madras goat virus has been employed to some extent.

Advantages of Goat Virus method over the Serum-Simultaneous Method.—Goat virus-alone inoculation is simple and easy for the operator as it requires only one injection of a very small dose whereas in the serum-simultaneous method two inoculations have to be made with virus and serum, the latter of which has to be calculated and adjusted according to the body weight of the animal.

2. There is less chance of introduction of piroplasmosis, etc., into cattle with goat virus than with the virus of bovine origin.

3. Serum disease in susceptible animals is eliminated by the use of goat virus-alone.

4. Immunization by goat virus costs less than four annas per head while that by serum-simultaneous method costs at least over a rupee.

It is therefore considered that Rinderpest Goat Virus-alone inoculations may, with advantage and economy, be adopted to control Rinderpest among cattle in place of the current, costly, cumbersome and complicated method of serum-simultaneous inoculations.

Efficiency of the Open Pan System of Making Sugar

BY

B. Narasimha Iyengar, B.A., Ph.D.

Agricultural Chemist to the Government of Mysore

Sethi and Sarkar have published a note "on the single pan method of manufacturing 'Khandsari' Sugar" in Part V, Vol. III of *Agriculture and Live-Stock in India.*

The Mysore Department of Agriculture has done a lot of work on similar lines during the years 1904-05 and 1906-07 and results obtained have been published in detail in the Reports of the Agricultural Chemist for those years. It was found quite possible to produce a good quality of fairly white sugar fit for direct consumption from the single open pan system. The point which had still to be investigated was its efficiency on a commercial scale, and an opportunity for such work presented itself in 1911. Results then obtained have been summarised in *Sugarcane in Mysore,* Part II, published in No. 3, Vol. V of this *Journal.*

The work was conducted on the estate of Oorgahalli belonging to Mr. N. Krishna Iyengar for a period of 10 days. The juice was boiled by the open pan system but not in a single pan. It was in fact a three-pan system—two of the pans being on direct fire. The outfit consisted of a round pan with flaring sides used as a strike pan and two rectangular pans for heating and evaporating the juice to a certain extent. The round pan and one of the rectangular pans were on two independent fires, and the flue gases from these two were used for indirectly heating the other rectangular pan.

Cold juice limed to neutrality or slight acidity as shown by litmus was put into the rectangular pan heated by flue gases, and then run on to the other rectangular pan. At the commencement of work each day, both the rectangular pans were filled with juice limed in the cold. Scum was usually removed in the rectangular pan on direct fire, and partially concentrated syrup was filtered into the round pan.

About 300 lbs. of juice were put in at every charge, and it used to take $2\frac{1}{2}$ to 3 hours from start to finish, *i.e.*, from cold juice in a rectangular pan to discharging of the massecuite from the round pan. As the process was more or less a continuous one, about 2,400 lbs. of juice could be boiled in a working day of 8 to 9 hours.

The cane used for experiments was the local pattapatti or striped cane—a soft variety with about 8 to 11 per cent fibre in it. The juice was extracted in a 3-roller power mill with a capacity of one ton of cane per hour and made by Smith & Co., of Glasgow. The extraction from the mill varied from 72 to 78 per cent on the weight of cane or was 75 per cent on an average.

The whole work was done under strict chemical control and all losses during the process of manufacture were carefully determined. All information with regard to weight of juice boiled each day, its composition, weight of rab or massecuite obtained, weight of sugar, etc., is given in Table I appended. The sugar obtained was fairly white, contained very little invert sugar and was sold for direct consumption.

Table II gives the yield of massecuite, etc., by the Mysore process as compared with the Patna process mentioned by Sethi and Sarkar. It is seen that there is some difference in the yield of massecuite from

the 2 processes as calculated on the weight of cane as well as juice. The massecuite in Mysore does not seem to have been boiled to the same thick consistency as in the Patna process and consequently the ratio of sugar to the massecuite is a bit low in the Mysore process. But the efficiency of a process is to be judged from the quantity of sucrose in juice recovered as marketable sugar and judged by this standard the Mysore process is no way inferior to but slightly better than the Patna process.

The quality of juice used in the Mysore process was of a distinctly higher purity than that used in the Patna process, but it contained slightly more glucose as seen from figures given in Table III. The same table brings out clearly that the quality of sugar in the Mysore process was distinctly superior to that produced by the Patna process in that it shows a higher polarization and a lower invert sugar content.

Table IV gives the weights of all items during the 10 days of work, and shows losses due to thorough skimming as well as due to inversion during boiling.

Side by side with the making of sugar, Mr. Krishna Iyengar was making gur or jaggery in one of his own pans for comparison. About 11,850 lbs. of juice were boiled and 2,419 lbs. of jaggery obtained from it or 20.4 per cent on the weight of juice. The recovery of sugar manufactured at the same time was only 8.8 per cent on the weight of juice boiled as seen from Table IV, *i.e.*, less than 45 per cent of the weight of jaggery. Under such circumstances it is worth while considering whether sugar making by the open pan system will pay at all in competition with modern sugar factories working in India itself. With improved methods of milling and manufacture, modern sugar factories can and do surely recover much more sugar from cane than the " Khandsari " system ever can with the crude milling and boiling appliances at disposal.

Whether it is worth while spending further time and money on trying to improve the " Khandsari " system is a matter for serious consideration.

Table I.

Showing the composition of (1) *Raw juice,* (2) *Massecuite,* (3) *Sugar and* (4) *Molasses.*

Particulars.	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.	8th day.	9th day.	10th day.
Juice.										
Weight lbs...	3,350	2,400	2,400	3,600	2,400	2,400	2,400	2,400	1,800	2,400
Brix per cent	20.16	18.94	18.96	19.03	19.52	19.21	18.82	18.92	18.78	18.68
Sucrose per cent	18.79	17.08	17.15	17.49	18.15	17.76	17.45	17.55	17.15	16.95
Glucose per cent	0.57	0.71	0.95	1.03	0.60	0.89	0.98	1.14	1.11	0.92
Purity	93.19	90.16	90.42	91.87	93.01	92.47	92.68	92.72	91.31	90.74
Massecuite.										
Weight lbs...	749	489	504.5	747.5	542	515.5	491	511	368.5	508.5
Brix per cent	84.73	85.85	86.45	86.85	87.85	88.55	86.35	85.35	85.90	86.85
Sucrose per cent	74.17	70.00	71.25	70.00	66.25	72.50	70.00	70.00	72.00	67.50
Invert sugar per cent ..	9.63	10.85	11.90	11.50	13.15	12.50	13.15	13.15	11.35	14.00
Purity	87.52	81.53	82.41	80.60	75.43	81.89	81.06	82.02	83.81	77.71
Sugar.										
Weight lbs...	306	200	208	323	181	212	212	231	167	209.5
Sucrose per cent	98.00	97.00	97.00	97.00	96.00	96.40	97.00	96.60	94.60	97.00
Invert sugar per cent ..	0.63	0.37	0.39	0.54	0.60	0.50	0.52	0.59	0.63	0.78
Molasses.										
Sucrose per cent	52.00	47.50	46.25	43.75	44.00	45.00	41.25	43.75	43.75	45.00
Invert sugar per cent ..	16.66	18.00	20.80	25.00	25.00	20.85	22.50	22.50	25.00	23.00

TABLE II.

Serial No.	Particulars.	Mysore.	Patna.
1.	Yields per 100 lbs. cane—		
	(*a*) Juice	75	63.49
	(*b*) Massecuite	15.92	11.05
	(*c*) Sugar	6.75	5.25
2.	Yields per 100 lbs. juice—		
	(*a*) Massecuite	21.23	17.41
	(*b*) Sugar	8.8	8.28
3.	Yields per 100 lbs. Massecuite—		
	(*a*) Sugar	41.45	47.55
4.	Efficiency (sucrose in sugar to sucrose in Massecuite)	56.9	60.02
5.	Efficiency (sucrose in sugar to sucrose in juice)	48.2	46.8

TABLE III.

Showing the average composition of (*a*) *Juice,* (*b*) *Massecuite,* (*c*) *Sugar and* (*d*) *Molasses.*

Serial No.	Particulars.	Mysore.	Patna.
1.	*Juice :*		
	(*a*) Sucrose%	17.55	16.40
	(*b*) Brix%	19.10	19.15
	(*c*) Purity	91.87	85.65
	(*d*) Glucose%	0.89	0.74
2.	*Massecuite :*		
	(*a*) Sucrose%	70.37	73.44
	(*b*) Brix%	86.47	89.48
	(*c*) Purity	81.37	82.36
	(*d*) Invert Sugar%	12.12	8.80
3.	*Sugar :*		
	(*a*) Sucrose%	96.66	92.71
	(*b*) Invert sugar%	0.55	3.19
4.	*Molasses :*		
	(*a*) Sucrose%	45.00	43.48
	(*b*) Invert sugar%	23.00	14.02

TABLE IV.

Weight of juice boiled	25,550 lbs.
Weight of Massecuite	5,426½ lbs. or 21.23% on juice.
Total sugar obtained	2,249 lbs. or 41.5% on Massecuite or 8.8% on juice.
Sucrose contained in juice	4,500 lbs.
Sucrose recovered in sugar	2,168 lbs. or 48.2%
Sucrose lost in scum	1.5%
Sucrose lost by inversion	10.3%

The Agriculturists and the Co-operative Movement

BY

G. M. Mehkri, B.A., LL.B.

Registrar of Co-operative Societies in Mysore, Bangalore

It is rather unfortunate that the value of co-operative societies as very necessary and helpful institutions to the agriculturists has not yet come to the knowledge of most of the villagers. The very fact that just as the Governments of all civilized countries have established schools, hospitals, courts and such other institutions for the development and well-being of their subjects, they have also created a department for the organization and inspection of co-operative societies, is proof of the wide possibilities of these institutions in promoting the welfare of the people. Though it is not possible to describe them all in this small article, a few of the important points may be indicated here.

It is true that this movement was created chiefly for the benefit of the ryot. Raffaisen founded the movement mainly to remedy the disabilities under which the agriculturist is labouring. What those disabilities are and how they can, to some degree, be remedied by the formation of co-operative societies will now be briefly discussed.

Agriculture is the main industry of this country and there is

no doubt that it needs just as much capital as any other industry. It is a regret that an agriculturist in any country rarely has enough cash to improve his lands, to procure such necessaries of cultivation as ploughs, manure, seed, etc., to pay for ploughing, sowing, transplanting, weeding, harvesting and such other agricultural operations, and oftentimes, even to pay land revenue; and in India, it is even more so. He has to borrow the necessary capital initially for all these purposes. As the yield from this industry generally comes only once a year, and even that is precarious, commercial banks which must needs keep all their transactions current do not find it convenient to advance loans to agriculturists. It is also natural for individual capitalists who generally reside in large cities to hesitate to grant loans to agriculturists of far-off villages, as they have no close knowledge of the real circumstances of the villagers. Owing to these reasons, the ryot not being able to obtain the necessary capital in time (it need not be said that unless he gets the capital in time, he will lose a whole year's revenue) on reasonable terms, will be driven to the necessity of borrowing from any quarter even at exorbitant rates of interest and on other disadvantageous terms. Unable to meet even the interest charges on such loans from out of his meagre income his debts run from generation to generation. This is really deplorable. Such an economic evil can be remedied to a great extent by the co-operative movement. Credit facilities which are not ordinarily available to the villagers as single individuals, can be easily secured when the villagers combine themselves to form co-operative credit societies, taking in as members only such men as are hardworking, deserving of help and trustworthy and offer a joint liability. The capital thus obtained may be distributed among themselves according to individual needs, character and creditworthiness; and it would be possible for them to discharge such debts from out of their income only. While their current needs and the capital necessary for the annual cultivation of their lands can be secured on quite favourable terms, through these institutions, facilities can also be provided for discharging their old and heavy debts by obtaining sufficient funds from land mortgage banks. Besides thus obtaining loans on very fair terms through co-operative societies they can greatly reduce other expenses incidental to borrowing owing to the concessions afforded to such institutions by Government.

While the credit facilities which the agriculturist derives from these banking institutions are in themselves great boons to him, they fade into smaller significance when compared with the benefits he may in other ways derive by the establishment of co-operative societies. However facile the debts may be, if he does not secure a sufficient income to repay even that, he can never be free from debts, and his economic position is no whit improved. It is futile to suppose that the ryot can repay his debts from out of his present income. He can do so only if he improves his present income, that is, the profits of his industry, and that he can do it in three ways: Firstly, he has to reduce the cost of production, secondly, he has to increase production, and thirdly, he has to obtain better money return for the production. Let us now consider briefly, how co-operative societies can help him in all these three directions.

The smallness of the holdings of our ryots and the economic waste in cultivating such small holdings individually are well known. However small the holding may be, its owner has to maintain at least a pair of bullocks, a cart and one plough for its cultivation. Besides, it is neither possible nor necessary for each holder to furnish himself with the modern improved appliances. In these circumstances, it can be easily seen how much the expenditure on bullocks, ploughs, carts and machinery can be cut down by organizing societies and carrying on cultivation collectively. For irrigation purposes also there will be no need for each individual holder to have a separate well for himself and install separate pumps. The adjacent land owners may all combine, have one common well of sufficient capacity, install one pump, irrigate their individual lands, and divide the cost according to the area of each one's land. Similarly, they can commonly own big machinery, use them accordingly to their individual needs and share the costs according to the use. It is easy to multiply such illustrations of co-operative cultivation.

Further, it is easily understood that even with regard to the purchase of the individual needs in seeds, manure and implements the cost can be greatly reduced by clubbing their needs and making a joint purchase. A co-operative society would be helpful in this respect also. So much about reducing the cost of production.

A more important factor in raising the ryot's income is to secure

a reasonable price for his produce. Under the present conditions of marketing a ryot's produce will have to pass through the hands of a number of middlemen between him and the retail dealer and there is thus a very wide margin between the price which he gets for his produce and the price at which it is ultimately sold to the consumer. While the ryot is getting poorer and poorer by the small money return he secures for his labours, these middlemen whose only work is to pass the produce from hand to hand have, in fact, fattened on the labours of the farmer. This is not all. The unfair dealings which these middlemen force on the helpless and unorganized agriculturists and the loss and injustice suffered by the latter under their hands need not be emphasized. With the present system of marketing the ryot cannot but resort to these middlemen for selling his produce. It is not possible for every agriculturist to take his small produce to outside markets where good prices can be obtained. Even if that were attempted, the cost of transportation, etc., will swallow all the extra profit that he may possibly obtain therefrom, and he cannot afford to spare the time necessary for such journeys, nor does he possess the necessary technical knowledge to market his own goods. But if, on the other hand, the ryots combine and organize societies for the co-operative marketing of their produce, employing technical men for it, they can eliminate the whole chain of middlemen, save for themselves the profits now flowing into the pockets of these men, obtain a fair return for their labours and thus considerably improve their economic position.

It will thus be seen how co-operative societies can in these several ways be instrumental in improving the condition of the ryots. In addition to these economic advantages obtainable by the village dweller from these institutions, they will prove greatly helpful in undertakings of village improvement and the provision of amenities to the villager. It is therefore trusted that while the inhabitants of villages where such institutions already exist will unanimously work to improve them, the inhabitants of villages which have not yet got them will organise societies and work them in such a way as to derive all the aforesaid benefits.

Extraordinary General Meeting

An Extraordinary General Meeting of the Mysore Agricultural and Experimental Union was held on Sunday, the 25th February 1934, at 4 p.m., in the premises of the Agricultural Department, Bangalore, as per agenda hereunder :—

1. To consider the financial position of the Union in the light of the recent Government Order regarding the subvention for the years 1933-34 and 1934-35,
2. Accepting the resignation of Dr. Leslie C. Coleman, C.I.E., M.A., Ph.D., President of the Union, on the eve of his retiretirement from service, and
3. Election of new President.

At 4 p.m. Dr. Coleman, our President, and Mrs. Coleman arrived and were led to the assembly hall. After the President took the chair the meeting opened with an invocation. The Secretary read his report which mainly dealt with the difficult position in which the Union stood and submitted the accounts for the previous year. The President moved the adoption of the report and the accounts. These were formally adopted. The Secretary then read before the meeting Dr. Coleman's letter of resignation of his office of President of the Union, which was necessitated on account of his leaving India on retirement. A resolution on the President's resignation was brought before the House by Mr. T. Narasinga Rao and supported by three gentlemen, *viz.*, Messrs. N. Siddalinga Devaru, S. Venkataswami Gowda and J. V. Chennappa. The resolution, the text of which is printed elsewhere, was passed unanimously. Dr. and Mrs. Coleman were then garlanded with loud cheers from the members and to the accompaniment of a song by Sjt. Sreenivasamurthy, an young boy of ten. The President, unable to remain standing, begged pardon of the House and spoke in reply to the resolution, sitting down.

Another important item of the evening's function was the unveiling of the portraits of the late Dr. K. Kunhi Kannan and Mr. B. C. Shantappa who served with distinction in the Entomological Section of the Agricultural Department and passed away suddenly. The Entomological Section of the Department took advantage of the occasion to have the portraits unveiled. Dr. Coleman unveiling the portraits spoke as follows :—

"GENTLEMEN,

One thing more. The Union has asked me to unveil the portraits of two of my old colleagues who have passed away from our midst. I refer to Dr. K. Kunhi Kannan and Mr. B. C. Shantappa. Both of these gentlemen were associated with me in the activities of the Agricultural Department, *i.e.*, in the Entomological Section of the Department, and both of them left very distinct marks on the agriculture of Mysore. I am sure that you will be delighted to have these representations of them to remind you of the distinguished work that these South Indians, shall I say, have done in the service of Mysore."

After tea the members bade an ovatious preliminary farewell to Dr. and Mrs. Coleman and they left.

The meeting reassembled with Mr. H. V. Krishnayya, retired Officiating Director of Agriculture, in the chair. Two more resolutions were moved before the meeting and passed, one electing Mr. A. K. Yegnanarayana Iyer, the succeeding Director of Agriculture, as President of the Union and the other appointing a deputation consisting of Messrs. B. Venkatanaranappa and N. Siddalinga Devaru to wait upon the Second Member of Council for explaining the position of the Union and praying for the continuance of Government support.

The Meeting terminated with the singing of National Anthem.

The Secretary's Report, Dr. Coleman's letter of resignation, resolutions passed at the meeting and the President's address are published in the following pages.

Secretary's Report

GENTLEMEN,

I have mixed feelings of pleasure and regret to welcome you to this Extraordinary Meeting of the Mysore Agricultural and Experimental Union.

Under ordinary circumstances we should have met in annual meeting some time in November or December last year. Our uncertain financial position and the unfortunate illness of our President were responsible for the meeting being postponed. As contemplated then the annual meeting should have been held during this

month at Mandya so that an interesting field-day including visits to the Sugar Factory and the four Government Sugarcane Farms might be arranged. In the meanwhile extraordinary circumstances have arisen. Our President is retiring from public service in Mysore. Almost simultaneously, Government have delayed to sanction subvention to the Union. There is a liability of Rs. 2,265-1-0 as against a cash balance of Rs. 254-12-10 to-day. Not having had the slightest suspicion that the subvention would be discontinued, we have incurred expenses. Encouraged by Government in connection with popularizing our Kannada *Journal* among the Village Panchayets, we have made fairly extensive propaganda and so far enlisted the support of nearly 300 Village Panchayets. Government not having sanctioned the subvention we find now that we cannot satisfy the demand of our own creation. The *Journals* have been suspended. Our President in the capacity of Director of Agriculture has again addressed Government in the matter. It is too early to say what might be the result of his effort. This is a matter which you will have to seriously consider during this meeting.*

Our President is, as you all know, the Founder of the Union and its President since its formation in 1918 excepting during the periods he was on leave. In the earlier years he was its main support even financially. It is not for me to say anything about his services to the Union or to the State. That will be the subject of a resolution to be shortly moved for your consideration.

If you will permit me a personal note, I beg to say that I have been your Secretary for the last fifteen years. I have tried to serve you to the best of my capacity. It has been my peculiar good fortune and proud privilege to have been closely associated, in however humble a measure, with our President Dr. Coleman during this period. He has been to me, as he has been to so many of us, a source of never-failing inspiration and guidance. I am ever grateful to the Union for the opportunities for service I have been afforded. It is now my painful duty to request you to adopt this rather depressing report and the statement of accounts attached.

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*Government have since kindly granted subvention to the Union for two years.

Statement showing Receipts and Expenditure from 1st December 1932 to 24th February 1934, as adopted at the General Meeting of the Union held on 25th February 1934

Receipts.	Rs.	a.	p.	Expenditures.	Rs.	a.	p.
Opening Balance ..	1,667	8	9	Establishment	2,076	5	11
Admission fee	135	0	0	Printing	31	15	6
Membership fee ..	552	8	0	Postage	85	0	6
Subscription	374	6	0	Annual Meeting and Field-Day	282	8	10
Miscellaneous	60	3	10	Miscellaneous (Stationery, etc.) ..	58	15	0
				Total ..	2,534	13	9
				*Cash on hand	254	12	10
Grand Total ..	2,789	10	7	Grand Total ..	2,789	10	7

*Details for Liabilities amounting to a total of Rs. 2,265-1-0 are omitted.

N. Venkatsubbaya,
Secretary.

Dr. Coleman's Letter of Resignation

Bangalore,
24th February, 1934.

Sir,

I have the honour to place in your hands my resignation as President of the Mysore Agricultural & Experimental Union. This has become necessary on account of my leaving India on retirement. My memories of the Union are of the pleasantest and I wish it every success in the future.

I have the honour to be,
Sir,
Your most obedient servant,
Leslie C. Coleman.

To
The Secretary,
The Mysore Agricultural & Experimental Union,
Bangalore.

Resolutions

1. The Members of the Mysore Agricultural and Experimental Union learn with deep regret that their President Dr. Leslie C. Coleman, C.I.E., M.A., Ph.D., Director of Agriculture in Mysore, retires from

service and is leaving our country immediately owing to his impaired state of health. They feel that they are losing the services of a friend who had fully identified himself with the Mysore ryot for so many years and was ever a guiding star in all their movements. His practical knowledge of agriculture, his deep insight into the agricultural conditions existing in Mysore and his burning desire to improve the lot of the Mysore agriculturist have stood him in good stead in winning the affections of the Mysore ryot. The great improvements that have taken place in Mysore agriculture ever since his advent bear ample testimony to his ability and far-seeing policy. His stern sense of duty even under the most trying circumstances has been remarkable; and his name has become a household word among the agriculturists for efficiency, disinterested service and kindly fellow-feeling.

The members of the Union desire to place on record their deep sense of appreciation of the very valuable services of Dr. Coleman to the cause of agriculture in Mysore, and wish him a long, happy, useful and peaceful life in his own country. May he ever have a warm corner in his heart for the Mysore Agriculturist!

Proposer :—Mr. T. Narasinga Rao.

Seconders :—Messrs. N. Siddalinga Devaru, S. Venkataswami Gowda and J. V. Chennappa.

Passed unanimously.

2. Resolved that Mr. A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D., be elected President of the Mysore Agricultural and Experimental Union in the place of Dr. Leslie C. Coleman, C.I.E., M.A., Ph.D., who has resigned on retirement from service.

Proposer :—Mr. N. Siddalinga Devaru.

Seconder :—Mr. M. S. Linge Gowda.

Passed unanimously.

3. Resolved that this meeting of the Members of the Agricultural and Experimental Union authorize Messrs. N. Siddalinga Devaru and B. Venkatanaranappa to wait on the Second Member of Council to represent to him the present financial condition of the Union, and pray, on behalf of the Union, for the continuance for some more years of the subvention till now granted by the Government for carrying on the useful work that is being done by the "Union" in the interest of the agriculturists of the State.

Proposer :—Mr. M. S. Linge Gowda.
Seconder :—Mr. N. Krishniengar.
Passed unanimously.

Dr. Coleman's Reply

Mr. Narasinga Rao, Mr. Siddalinga Devaru, Mr. Venkatasami Gowda, Mr. Chennappa, and Gentlemen,

I hope you will pardon me, if I say what I have to say, this afternoon, sitting down. I am still anything but well, and I fear that if I attempt to stay very long on my feet it may not be very good for me. I thank you, Gentlemen, for the resolution that you have passed this afternoon in connection with my service to this Union and to the State and I thank you for the kind words that you have used in supporting that resolution.

During the last two months, when I have been living, if I may say so, in partial purdah, I have had ample opportunity to look over the events of the twenty-six years of service, which I have done in this State of Mysore. When I came here something over twenty-six years ago, I knew, of course, absolutely nothing about Indian conditions in general, or the conditions of Mysore in particular. But it was not more than a year after I arrived here, that I had made up my mind that it was my duty to devote the years which I should be spared for work in Mysore, to one main object. That main object was to be, as I saw it even in those days, to build up an organization manned by Mysoreans which would be of permanent and lasting benefit to the agriculture of this State. I think I have told you once before, perhaps many times, that I had spoken of this to that great friend of mine, the then Dewan Mr. T. Ananda Rao, shortly after he took charge of the administration of the State, that I should like to use my best efforts during all the years that I should serve here, to develop an organization which would be of permanent benefit to Mysore agriculture. Now, in the history of a State, twenty-six years is an extremely short time and I had no ambition or no expectation of seeing in the period of twenty-six years a revolution in Mysore agriculture. What I hoped would be a skeleton at least of the different activities and organizations which taken together would make up a really up-to-date Agricultural Department. I thought that if I could see before my retirement that organization in being I should at least have justified to some extent the trust of the people

of this State and its Government. I think I can say now quite definitely that that organization is there, not in its entirety, but in the form of a skeleton. You have here in the Agricultural Department, the Veterinary Department—I should not forget it—which came under my charge some thirteen or fourteen years ago, the Serum Institute which was organized still later and the Amrit Mahal Department which is being gradually transformed into the Live-Stock Section of the Agricultural Department, a skeleton of almost all that which you should require for investigation and demonstration work for the advancement of Mysore agriculture.

When I came back to this State in the year 1928, some of these activities were either in their infancy or were not yet started. I would refer particularly to the Serum Institute which had just then been started and to the Live-Stock Section which existed hardly more than in name. The Coffee Station itself was but in its infancy then. It had to be thoroughly organized. Moreover, at that time the development of the great Krishnaraja Sagara Irrigation Scheme was still under consideration. During the last six years, I have been fortunate enough to have been associated with the development of all of these many and varied activities. A number of my friends have expressed regret that I should not have been able to spend some more years here to see some of the fruits of these numerous activities. Gentlemen, I too regret that that is not to be the case, but after all, the organization is there, the staff is there, and it is for you, the agriculturists in general and the staff in particular, to carry through the work to its fruition. Once more I wish to impress upon you that I have never had any expectation of seeing large developments brought to fruition in the short space of my life here. But if I can be remembered as having been associated with these activities I shall be happy. I consider myself extremely fortunate in having been for a longer period than any other one man in charge of all these activities connected with the Agricultural Department. This I consider an extraordinarily great stroke of fortune for me personally.

Now Gentlemen, I cannot talk long to-day. All I wish to say is that I go away from here with the kindliest feelings to all those with whom I have been associated, with feelings of most profound loyalty to His Highness the Maharaja and the present Government

of His Highness the Maharaja and with feelings of most profound gratitude to the many officers of the State, some of them already gone with whom I have been associated and under whom I have worked for the last twenty-six years. I carry away with me very very cherished recollections and memories which will be with me wherever I am, as long as I live.

Now to the younger men who are here, I wish to assure you that as far as the Agricultural Department is concerned, I have a feeling of very great confidence in the officers that have been left behind to carry on this work. There is not one man alone but several who are quite capable of directing the activities of the Agricultural Department in the future along the lines which have been marked out and along better lines which may hereafter be developed. I feel quite certain that the Agricultural Department in the future will be as successful, as useful as, and even more useful, than it has been during the past. The idea, if it is in your minds at all, that an organization is dependent upon the existence of one man, is an absolutely false idea. You must realize that perfectly well. It would be a sad thing indeed if the fact that one man disappears either through natural efflux of time or any unfortunate cause, it should lead to cessation of activities. No, it is not so. The work must go on irrespective of him. I have also the satisfaction of knowing that in regard to the development of this Department foundations have been laid upon which I am perfectly certain a structure, a worthy structure, will be raised which will be of great benefit to the agriculture of this State as a whole. Under these circumstances, Gentlemen, I think I can leave with thoughts of pleasure in my heart mingled with thoughts of regret that I shall not be present here to see some of the developments of the activities with which I have been so closely associated. I am perfectly certain, however, that I have friends here who will keep me informed of all the developments and I wish to assure them that I shall be only too delighted to hear from every one who cares to write to me wherever I shall be—I do not know where my future home is going to be, but presumably it will be Canada. I shall be delighted to hear of all your successes and I am sure they will be many.

I thank you all for your kindness this afternoon and I hope you will excuse me for not enlarging my speech because I feel extremely tired.

Hebbal Agricultural School

A delightful function was held at the Hebbal Government Agricultural Farm, situated about 6 miles from Bangalore, on the evening of the 15th March 1934, when Mr. S. P. Rajagopalachari, Second Member of Council, performed the pleasant ceremony of presenting diplomas to the successful students of the Agricultural School.

After tea the proceedings opened with invocation. Dr. V. K. Badami, the Principal of the Agricultural School, then presented the annual report.

PRESIDENT, LADIES AND GENTLEMEN,

It gives me great pleasure to welcome you here and to offer you our heartfelt thanks on behalf of the staff and students for your consenting to preside on this occasion and presenting the Diplomas and Prizes to the successful students.

Owing to several unavoidable circumstances we were not able to conduct the usual festivities connected with the School Day and we regret very much that this time it is mainly a business function. When the periods of depression and strain are over, we fondly hope to revive the "Gala Week". Farmers as we are, we always complain against everything in the world but we do our duty and always hope for something better to turn up.

The retirement and departure of Dr. Leslie C. Coleman from Mysore has been a very serious loss to the School. This institution was started in 1912 by Dr. Coleman with the splendid support given him by the late Mr. H. V. Nanjundiah, the then Member of Council. Since then Dr. Coleman was the *ex-officio* Principal of the School till 1931. Under his fostering care the School gradually developed. From a two years' certificate course the period of instruction was extended to three years and in 1920 Government graciously consented to award the Diploma of L.Ag. to the successful students. Practically the whole of the district staff and a number of other important posts are now composed of the students of this institution. The general agricultural development in the State and especially the successful manner in which the Irwin Canal tract has been developed bear testimony to the capacity and technical training of the students who have gone out of this institution. In my last year's report I pleaded for the conversion of this School into a College.

Dr. Coleman was also keen on this development, for he fully believed in attracting the best of the local talent to agriculture. In his retirement we have lost a powerful supporter. We are very grateful to him for all that he has done to this School and we, the staff and students, wish him a safe journey home, a speedy recovery from his illness and a long, happy and prosperous retired life in his home country. The true homage we can pay him lies in the direction of the development of this school into an institution worthy of the name of Mysore and help it to occupy a useful position in our national life. For this development we now earnestly look forward to the guidance and support of the present Director and the Government.

There has been a steady progress in the School during the year. The demand for seats is ever on the increase, in spite of the fact that there are not many openings in the Department. In 1932-33 about 156 applications for admission were received and 40 of them were admitted. Twenty-nine students sat for the examination and 21 secured the Diploma, three of whom passed in first class with honours. At present 94 students are in residence. The hostel and class-rooms are packed to the utmost. The time has come now to consider seriously the question of housing the School and the students in new buildings. The old stables, barns and store rooms which had been hurriedly converted into class rooms served the purpose exceedingly well but we now earnestly hope that a separate set of buildings large enough to accommodate the laboratories and workshop, the necessary adjuncts of any efficient agricultural school, will be made available.

Our students have been very successful in the field of sports and other activities of club life. In cricket they have met the best clubs in Bangalore and have carved out for themselves a place in first class cricket in the State. Their success in hockey, football and tennis also has been praiseworthy. The debating club has been very active during the year. The activities of the Karnataka Sangha have drawn to this place, on several occasions, leading Kannada authors and scholars. Our students and the enthusiastic villagers round about have had the benefit of their experiences. Our thanks are specially due to Mr. M. Venkatesa Iyengar, Prof. B. M. Srikantiah, Mr. A. R. Krishna Sastry, Mr. C. K. Venkataramiah and Mr. T. T. Sharma. Our thanks are also due to Lt.-Col. B. P. Krishne Urs for

the interest he is taking in the School. He is sending one of his officers to train our students in the elements of drill on Saturday mornings. These classes are helping us to train our Scouts and to develop, to a great measure, the instincts of discipline and leadership, two essential qualities required in public life. It is our earnest hope that the students who settle down on their estates will, in turn, influence rural life and form centres of progressive social and agricultural activities.

The hostel life continues to be satisfactory. We are trying to keep down the cost of living to last year's standard of Rs. 8 per mensem for meals alone. The drinking water from the bore-well has been very conducive to the health of the students. There has been no serious illness amongst them.

Last year we had laid out a good cricket field and pavilion near the Palace in the new Butts area at a cost of Rs. 500. We are now handing them over to the Military and making arrangements to lay out a separate field near the Serum Institute. We request the Director to persuade the Government to help us in laying out a permanent playground.

As a first step towards the conversion of the School into a College, I have already submitted proposals to the Director for securing sanction of Government. In most of the agricultural institutions in British India while only the Diploma of L.Ag. was conferred by the Government, the Institutions were called "Colleges" and the instruction was of the University standard. In this Agricultural School of ours, the Diploma of L.Ag. was first granted by Government in 1923. I have submitted that with slight modifications in practical instruction in the science classes and by admitting only the E.C. & P.S. students the standard of training can be easily raised and that the name of the Mysore Agricultural School can conveniently be changed to that of the Mysore Agricultural College. The proposal will not cost the Government any extra expenditure but will greatly add to the status of the institution and attract students who are all of the level of the University standard. When this change has worked for some time and better days dawn, it will be an easy step to raise the level of instruction to the B.Sc. (Agri.) standard. I request the Government to consider the proposal sympathetically and enable us to effect the change during the next official year.

In my last report I pleaded for public and Government support for recognizing the true value of agricultural education and giving the students of agriculture the same status and value as those of a University Graduate. The urgency of the need for such a recognition is now greater than ever before. The problem of settling down the educated unemployed is now more acute than it was last year. A large number of trained students are going out of the School every year. There are no vacancies in the Department. All of them have not the means to take to private farming. The inducement is also not great on account of the fall in the prices of agricultural products. Facilities for growing commercial crops like sugarcane, are available only in the Irwin Canal tract. As coolies on daily wages of Re. 1 a day, a number of students worked recently on the various Government Farms to specialize in sugarcane cultivation. They hoped that they would be settled down on Government lands as tenant farmers to grow cane for the Factory or that they would be absorbed in the Sugar Company on fair salaries. But when they were offered permanent salaries of Rs. 20 or Rs. 25 they became disheartened and are now looking up to the Government for relief and support. It was at first thought that all Government lands would be available for the settlement of agriculturally trained men. The present trend of events does not indicate that way. I respectfully beg to submit, that as an experimental measure if one of the Government Farms is apportioned to a batch of students on the same conditions on which the farms are proposed to be handed over to the Sugar Company, there would be an opportunity to see if the scheme would work well. If the tenant farmers owning 12 acres on lease of 10 years show a marked success then there would be an opportunity for hundreds of educated men to settle on land. It would also demonstrate to this State and to the rest of India what applied science can do to improve agricultural life. The opportunity that might be made available to a large number of educated men to settle on land would readily change the aspect of the country side. The remarkable transformation that has taken place round about Mandya within the course of two years prompts us to forecast a greater transformation of the country in the hands of the educated. Such a scheme, I venture to say, would greatly help in the economic development of the country.

I have taken more time than I intended to take. But the immediate needs of the School and the distress of our unemployed students compelled me to refer to a few points that require the sympathetic consideration of the Director and the Government.

To the students who are receiving their Diplomas and prizes, I wish all success, happiness and prosperity in their life. The present dark clouds will soon vanish if you only have courage, faith in God and faith in yourselves. I am sure that you will ever bear in mind the fact that the School will be judged by the manner in which you conduct yourselves in life. I am confident that you will always try to add fresh honour and glory to your *alma-mater*.

I once again thank you, Sir, for the kindness you have shown us by being present here to-day. Under your lead and with your support we hope to give a better record of progress during the coming year.

Director's Speech

Mr. Yegnanarayana Iyer, Director of Agriculture, after welcoming those present, paid a warm tribute to Dr. Coleman.

He said : "I was associated with Dr. Coleman from the day on which he joined the Department to the day of his retirement. A man of brilliant scientific attainments he kept his mind fully stocked with the most up-to-date knowledge by his extensive reading and rapid assimilation. Opportunities for the expending of his knowledge and experience in many lines of agricultural work came to him thick and fast, both in India and abroad. Activities of the Department kept continually increasing in many directions and a number of institutions, Sericulture, Veterinary Science, Serum Institute and Live-Stock to mention only a few, were being absorbed into the Department, not the least important though the most recent activity being the Mysore Sugar Industry. Though eminently a man of science, he never forgot that he was the Head of the Department of Agriculture as well, the success of which can be measured only by the extent to which improved agricultural practices are popularised amongst the cultivating classes and ryots and planters practically benefitted. To this end he bent all the scientific research of the Department and also saw to it most carefully that practice never outran its scientific basis. The judgment and precision with which he drove this pair

Science and Practice, in double harness was truly remarkable. Add to this his long service, almost unique, of a quarter of a century. He was thus able to build up and hand down to us a most splendid reputation for the Department which I value as a priceless legacy. Truly can I say of such a man *Si Monumentum Requiris Circumspice*. Let us pray that God may grant him and his family long life, health and happiness.

Now, I shall make a brief reference to one or two points in the Principal's report. The first one is the question of opening of an Agricultural College in the State which he has urged and has been urging with considerable force and vigour. Let me say at the outset that nobody will be more pleased than I if the conditions in the State should warrant the opening of such a college. For one thing, the Department will be securing trained men of a much higher calibre who may in time be trusted to hold responsible positions. This matter of an Agricultural College is no new one. It is many many years old, but if I may use an Irishism, this unborn institution has been the victim of accidents. Years and years ago, Dr. Coleman drew up a modest proposal making full use of the higher staff of the Department and the equipment on the Hebbal Farm. There was every chance of its passing through, but it did not do so. The scene changed when Mysore was suggested as the centre and I remember inspecting several sites and showing them over to late Mr. H. V. Nanjundiah. The proposal then got caught up in the wheels of the University and if I am not mistaken, the University showed its preference for a Medical Faculty instead. It came up in a somewhat attenuated form on more than one occasion in the succeeding years, but somehow it dropped out of sight and nobody troubled to look for it. As Dr. Coleman said on this same subject last year, it is all a question of finance and such funds as he could get he was expending on what he considered to be more fruitful lines of work. I do not know if conditions have changed since he spoke, but should the opportunity arise, I shall not neglect it. I may also add that this is not a matter entirely for the Department, for the University is concerned in it, unless we do not want to keep in line with other parts of India and try to plough a lonely furrow.

The next point is the question of unemployment of the passed students of the School which is assuming somewhat serious

proportions and is bound to become worse. In this matter you have the sympathy of everybody. In a recent conversation with the Dewan Sahib (I may say without any breach of confidence) he showed his great concern in the matter and I do not think you can have a more powerful support. I shall do all I can to try to expand the staff in the Districts, if not in a big number at one time, at least in twos and threes, and I would take this opportunity to canvass with all the earnestness I can for the sympathy and support of our worthy President in this matter. But, when all is said and done, this can afford only very meagre relief. I think, you, students, ought to completely change your attitude and look at matters under the altered conditions and adjust your action accordingly. For one thing you must be prepared to seek service on private estates and, for that purpose, it is of the utmost importance that you improve very materially indeed your practical knowledge so that you may be able to satisfy your employers. I have in mind the idea of extension of the present course, not as an integral part of the curriculum, but open to such as may be willing to avail themselves of the opportunity. Work on the coffee estates, sugarcane farms, fruit farms, dairy farms and so on, will constitute the course of training and one may select whichever course one likes. But this is only a rough idea which I should like to develop and I hope that it might lead to material larger relief to the benefit of both the students and estate owners. I cannot refrain in this connection from expressing my disapproval of the action of some at least of the men who refuse to take advantage of the opportunities in the Education Department. If this attitude continues, I do not know what the consequences will be.

We are bound to furnish the necessary staff in a scheme for which we ourselves are largely responsible and if we fail to do so, it may react rather unfavourably on us to say the least of it.

As regards the idea of parcelling out sugarcane lands in Mandya as a colony for agricultural students, the idea has my full sympathy, although the word 'Colony' is not one likely to kindle enthusiasm just at present. With the sympathy of the Sugar Company and of your good self, Sir, I think it may be possible to do something in this line."

Press Report of Chairman's Remarks

After awarding Diplomas and prizes, Mr. S. P. Rajagopalachari, in a short speech, congratulated the Principal and the Staff of the

Hebbal Agricultural School on their excellent work. He said that the thought uppermost in his mind that day was the absence of Dr. Coleman from their midst and he need not add to what had already been said of Dr. Coleman and his great work. He would associate himself entirely with the remarks made by Dr. Badami, the Principal, and Mr. Yegnanarayana Iyer, the Director of Agriculture, regarding Dr. Coleman. He knew Dr. Coleman from the time he entered the State Service. Dr. Coleman always referred to the development of the Agricultural School into a College.

Mr. Rajagopalachari next referred to the various occasions when attempts had been made to raise the status of the School to that of a college, and said that for some reason or other they did not materialise.

Continuing the speaker observed that the importance of the School could not be over-stated so far as the State was concerned. It was the nucleus from which higher instruction of the college type must be developed. It was from this point of view the Government had always considered the claims of the institution to be converted into a college, but unfortunately for some reason or other the School had remained severely unchanged. Open invitations had been made to him (speaker) to help this Institution. Personally his sympathies were all with the School.

Mr. S. P. Rajagopalachari then referred to the two specific requests made by Dr. Badami in his report, *viz.*, the question of raising the School to the level of a college, and the question of providing lands on Government farms to those qualifying at the School.

The former, he said, was impossible until the State finances improved. As to the second he felt that there was not sufficient Government lands just then available. The area of the Government lands was going to be reduced and the Government wanted to give the ryots more opportunities in the Irwin Canal area where it was suggested land should be given to the agricultural diplomats. But if some more practical schemes were sent up, without their involving much financial commitments they would be considered. It might be possible for him to see that they were not summarily vetoed.

Proceeding, Mr. Rajagopalachari complimented the Principal and his staff on the excellent work that they were doing though under many handicaps and limitations. He said that the reputation of the School stood very high, when compared to the other sister institutions in India. All students from Hebbal School had been found to be fit for all kinds of agricultural work and they had been found to be quite capable of adapting themselves to any circumstances and needs arising out of the peculiar conditions under which they were called upon to work and grapple with.

Finally, Mr. Rajagopalachari congratulated the students of the School, who had passed out this year, and expressed great pleasure at his being called upon to distribute Diplomas. He wished them good prospects and all success in future.

SELECTIONS

Dr. Leslie C. Coleman, M.A., Ph.D., C.I.E.

(An Appreciation)

The news of the retirement of Dr. Coleman from the service of the Mysore Government will be received with widespread regret, not only within the State which he served for so many years, but among all those interested in agricultural development throughout Southern India. It is not often in India that a public servant passes the whole of his working life in such close association with one department that the mention of the department immediately recalls the man, and in this respect, Dr. Coleman and the Mysore Department of Agriculture are practically unique. When that association has been so productive of results for the benefit of South Indian agriculture, its end cannot but be a matter of public regret and occasion for some appreciation of the personality whose labours were primarily responsible for it.

Dr. Coleman first came to India as Mycologist and Entomologist to the Government of Mysore in 1908 after a distinguished university career in Toronto and Berlin. At that time the Agricultural service of the State consisted of a Chief Agricultural Chemist, Dr. Lehmann and five assistant chemists, two of whom were seconded for duty in the Geological Department. Dr. Coleman's appointment was the first step in broadening the basis of that service to include the study of diseases and pests of the crops grown in the State. Shortly after his arrival, Dr. Lehmann retired from service and to Dr. Coleman fell the task of reorganizing the department on a broad basis with the ideal of a comprehensive agricultural service for the benefit of the primary industry of the State. The history of the department since that date has been one of steady development towards the realization of that ideal. He leaves the State with a lasting memorial in the form of an efficient modern agricultural service whose members have been imbued with the ideal of scientific method and public service which he had constantly kept in view.

The tasks facing Dr. Coleman in the early stages of his career in Mysore were not only those of carrying out investigations on the diseases of economic crops and of beginning the organization of an agricultural department, but also of proving that scientific advice was of value and worth paying for. In those days the scientific advisor was regarded as

even more of a luxury than he is to-day and it was necessary to show both administrators and the public that an agricultural department was a profitable investment. In this, as in other tasks, he was completely successful. His work on the Koleroga of Arecanut and its control must be remembered, not only as a brilliant investigation of an important plant disease but as a striking and convincing proof of the commercial value of scientific investigation and advice.

This research was followed by others, equally successful if less spectacular, and even when the results were not of immediate practical value, yet they provided notable additions to our knowledge and supplied the basis for later developments. Dr. Coleman's pre-occupation in recent years with problems of agricultural development and administration has tended somewhat to overshadow the importance of his work as a plant pathologist, but it is only necessary to recall the studies of the transmission of Spike Disease of Sandal, the true nature of the fungus of Coffee Black Rot and the life history of the fungus of Arecanut Koleroga to show the range of his purely scientific attainments.

It is, however, in the organization of the Agricultural Department in Mysore that his main monument lies. On the technical side, the varied investigations on chemical, mycological, botanical and entomological problems affecting crops in Mysore which have been carried out by the departmental staff owe their inception to his wide knowledge and keen appreciation of the questions most urgently requiring study. No one who came in contact with him over technical problems could fail to be impressed by his acquaintance with the details of each investigation going on in the different sections of his Department. Even when his time seemed more than fully occupied in other directions, he kept in touch with scientific developments and his conversation and correspondence overflowed with ideas and suggestions for the use of his assistants and collaborators.

In the extension and educational work of the Department he was equally active and the scientific trend of his mind was never allowed to obscure the fact that the main purpose of an agricultural department is the improvement of the state of the agriculturist. His own great skill with both speech and pen was constantly used to spread the results of investigations, to explain the purpose of the work of the Department and to gain the co-operation and goodwill of the agriculturist. That he succeeded in all these directions is visible throughout the State where the utilization of modern methods of soil fertilization, of crop disease control methods and of improved varieties of crops shows not only the results of successful research but also of successful propaganda.

The range and scope of these activities were made possible by his labours in building up a team of efficient officers to assist him and in this, one sees the force and influence of his personality. No one who has come into contact with the Department could fail to be impressed with his deep interest in and loyalty to his staff and his constant readiness to assist them with advice and encouragement. He was rewarded by the deep loyalty and efficient enthusiasm of those he chose to assist him and the cordial co-operation which existed in the Department is a tribute not only to his skill in selection but also to the attraction of his personality.

By the planting community, he will always be remembered for his services to the coffee industry, both by his own investigations and by the establishment of the Coffee Experiment Station, where he and his Department extended such cordial hospitality to the Scientific Officer of the U.P.A.S.I. His absence from the Annual General Meetings of the Association will leave a gap not readily filled ; his speeches were always interesting and always helpful and his long and close relationship with planters, both in public and private, gave him an insight into the planters' point of view which was unique.

His long and distinguished public service in India has now come to an end but his influence and inspiration will continue among all those who were privileged to know him. It remains to wish him a complete recovery from the trying illness which necessitated his retirement and many years of happiness in his home country.—[*Extract from "The Planters' Chronicle," Vol. XXIX, No.* 6, *March* 24, 1934.]

A Renewable Edge for Ploughshares

A new product, which is claimed by its makers to revolutionize ploughing methods, is announced in America. It is described as an attachable ploughshare edge, and, as the name suggests, it slips on steel ploughshares easily and quickly without the use of bolts, nuts or lugs, the attachment being made in a few minutes and the combination of share and edge becoming tighter with use. The edge which is made of special steel, should not be used with a worn share or with one that has never been used, and it is said that the best method is to use the share in the ordinary way for a few rounds and then slip on the renewable edge, the ordinary share thereupon serving as holder for the renewable edge, which sharpens itself in use and remains sharp until worn out, thereby

ensuring the former a continuously sharp share and the avoidance of lost time through removing worn shares and substituting new ones.

In one example of application that is quoted in the United States, a renewable edge has worked throughout 13 acres of ploughing in gravelly soil without being worn out, whereas it is the custom to have shares re-sharpened every four acres.—*The Implement and Machinery Review*, Vol. 59, No. 704.

Effect of Environment on Cotton

By D. G. Sturkie

Studies were made to determine the influence of soil type, climatic conditions and soil moisture on the development of lint and seed in cotton. Plants were grown in two very different types of soils in large galvanized iron cans to study the influence of soil type. For studying climatic and soil moisture responses plants were grown in the field, protected against rainfall, and irrigated at different intervals. Determinations were made on each boll for length of lint, weight of boll, number of seeds, weight per seed, weight of lint per seed, weight of lint per unit weight of seed, and percentage of lint.

Soil type did not affect any of the characters studied. Cotton grown in soil from the Mississippi Delta produced lint and seed which were in all respects like that grown in Norfolk sandy loam soil from Alabama.

Temperature, humidity and evaporation had no measurable influence on the characters of seed cotton. Apparently cotton can tolerate the extreme of any of these encountered during this test without being adversely affected.

The amount of available moisture in the soil was the only factor studied which influenced the development of lint and seed in cotton. The influence of soil moisture may be briefly summarised as follows:—

1. The length of lint was markedly affected by the amount of soil moisture. A low moisture content caused a short lint to be formed. The critical period in the elongation of lint was for approximately 16 days beginning on the date of blossoming. It was possible to reduce the length of lint at least 3 mm. ($\frac{1}{8}$ inch) by reducing the soil moisture to a critical point. There appeared to be a certain minimum and maximum length of lint for this strain of cotton.

2. The weight per boll, weight per seed, weight of lint per seed, and lint index were reduced by a lack of soil moisture. The critical period

in determining these characters extends from 1 to 42 days after blossoming.

3. The percentage of lint and the weight of lint per unit weight of seed were increased by a deficiency in soil moisture. The period during which the lint percentage and the weight of lint per unit weight of seed were determined extended from 1 to 42 days after blossoming. The percentage of lint varied less with soil moisture changes than did the lint index.

4. The number of seed per boll was not markedly dependent on the environmental conditions. There was a tendency for the number to be reduced by extremely drouthy conditions. A heavy boll was largely due to an increase in the weight per seed and weight of lint per seed.

5. Favourable soil moisture conditions produced heavy bolls with a long lint, heavy seed, large lint index and low percentage of lint.—*Journal of the American Society of Agronomy*, Vol. 26, No. 1.

The Root System of *Coffea arabica*

By F. J. Nutman

East African Agricultural Research Station, Amani, Tanganyika

Arabica coffee is grown over a wide range of soils and conditions in East Africa. The soils vary from the deep almost unweathered volcanic ashes of Mount Meru to heavy clays. The acidity profiles vary also ; some are neutral or slightly alkaline at all depths, some comprise a surface layer near neutrality, overlying a more acid sub-soil, while others are acid throughout. Rainfall may vary from 80 to 100 inches in one area to 20 to 25 inches in another.

The root system of coffee varies very considerably from area to area, as might, indeed, be expected, but from a consideration of the 67 systems so far excavated, it is possible to define what may be called the typical root system of *C. arabica*. This is characterized by the absence of taproot, by the development of a number of vertical axial roots, and by the laterals turning downwards at varying distances from the trunk, giving rise to a system of roots which are evenly dispersed throughout the soil to a depth of nine feet or so, although in some districts they may be found at 14 feet from the surface.

This system may be modified by local soil conditions, such as rock and gravel strata, dry hardpan, high water-table and so on, whereby penetration of the roots may be more or less restricted.

The effect of soil acidity on the roots, as brought out by the field studies, is perhaps worthy of special mention. Coffee has previously been assumed to be an example of a plant which requires an acid soil for its optimum development. Comparison of the distribution of the roots with the acidity profile of the soil shews that this is not the case. Soils which are acid throughout show very poor development at all depths: where an acid sub-soil underlies a top-soil which is neutral or moderately acid, the feeder roots are virtually confined to the surface soil; but where the soil is neutral or nearly so throughout, the roots are found to be evenly dispersed. From field evidence only, and pending confirmation by experiment, the optimum acidity for coffee root growth is on the neutral side of pH 5.8.

One of the more serious problems in East African coffee culture is that of "overbearing and dieback". The young tree sets a heavy crop, only part of which matures. This is followed by leaf fall, the drying up of the crop, and the dying back of the branches. The tree rarely recovers completely, and at the best is a "passenger" for some years. The dieback of the branches is parallelled by dieback of the roots, the regeneration of which appears to take place with difficulty if at all. The roots in the surface soil seem more resistant to this subterranean dieback than the more deeply seated ones, or possibly they regenerate more readily. At any rate a tree which has had dieback is frequently found to be reduced to surface rooting, in areas where the natural habit may be the reverse.

In some areas, where the roots are confined to the top-soil by an acid sub-soil, excellent coffee trees can be grown by the use of considerable quantities of organic manure. It therefore appears possible that the correct treatment for trees subsequent to dieback is to increase the fertility of the top-soil, in order to provide a sufficiency of nutrients within the suddenly restricted range of the root system. (A summary of "The Root System of *Coffea arabica*," Parts I and II. *Empire Jour. of Expt. Agric.*, Vol. I, 3 and 4, 1933.)—*Tropical Agriculture*, Vol. XI, No. 8.

Notes on the Cultivation of the Pineapple (*Ananas sativus*)

As renewed interest is being taken in the Pineapple industry in Mauritius, the following notes, which are the results of experiments carried out during the last few years, are now published in leaflet form with the object of assisting persons who intend starting pineapple cultivation in the Colony.

Climate and Soil.—The pineapple thrives best in a light, open soil, whether sandy or loamy, as long as it is well drained, this is an essential condition for success. Clay soils are unsuitable on account of bad drainage. A gently sloping land is the ideal site to establish a pineapple plantation. Where the slope is too steep, the rows should be at an angle of about 45° to the slope, this will prevent erosion. Silt-pits should also be dug at intervals along the drains in order to collect the fine soil which will be washed down during the heavy rains. When the pits are full, the soil should be removed and spread along the rows where required. If the land is flat, it is advisable to dig drains in order to facilitate drainage.

The rainfall should be at least 50 inches per annum, and evenly distributed. In certain dry localities, irrigation may be resorted to, if possible; this will help the plants during drought. It is advisable to irrigate when the plants begin to flower, and at intervals during the fruiting season; this will assist in the formation of larger fruits. Where the rainfall is less than 50 inches per annum, and water is scarce, fairly good results may be obtained by either ploughing or forking the soil between the rows, at least five times a year, in order to retain moisture in the soil and keep down weeds. The broken surface acts as a mulch, preventing excessive evaporation. Pineapples will grow at all elevations, but the fruit is larger and has a better flavour when grown at altitudes of less than 1,000 feet.

Variety to be Planted.—There are several varieties grown in Mauritius, but the "Smooth Cayenne" is the only variety which is recommended for planting, it is the principal one now grown in Hawaii, Federated Malay States, Formosa, South Africa and other countries where there is a canning pineapple industry. Its superiority over allthe other varieties for canning purposes is now established and is unrivalled. The Agricultural Department is at present propagating this variety in order to have planting material available for distribution to planters.

Propagation.—The pineapple is propagated by suckers, slips and crowns. When suckers are abundant, it is preferable to make use of them when starting a plantation, because the plant will fruit earlier than if raised from slips or crowns. The suckers should be planted from December to February, they will bear fruits in about a year from the time of planting. Slips and crowns will require nearly twice this time before fruiting. The "Smooth Cayenne" bears very few slips, some plants none at all.

A new rapid method of propagation is to cut from old stumps rings about half an inch thick, soak them for five minutes in a 4 per cent

solution of Permanganate of Potash, dry them well and then plant on a bed of sandy soil. It is advisable to place a glass cover over the bed, in order to shelter the rings from heavy rains, and thus be able to regulate watering which, if excessive, will cause many rings to rot, before the dormant buds begin to grow.

A " sucker " is a small plant produced in the axil of a leaf at the base of the old plant. The " Smooth Cayenne " has generally from two to three suckers per plant.

" Slips " are similar shoots or buds which are borne below the fruit ; many fruits of the " Smooth Cayenne " do not bear any slips. They are found in large numbers on certain varieties like the " Bourgault", for example.

A " Crown " is the top knot of leaves on the fruit ; the plants grown from crowns take two years before they flower.

Old pineapple stumps should be pruned of their leaves, the roots trimmed and then planted in furrows like sugarcane cuttings. They should also be covered with about two inches of soil. After a month or so, they will produce an abundant number of shoots, which may be removed when sufficiently strong to be transplanted into the field.

When propagating the pineapple, only the strongest and the healthiest plants should be selected, all weak and diseased plants must be discarded. If the latter are used for propagation, the chances are that a crop of inferior fruits of little or no market value will be obtained.

Before planting suckers, slips or crowns, a few of the lower leaves should be removed in order to facilitate rapid rooting, and also to get rid of any mealy bugs and other insect parasites which may be hiding under the leaves. The basal end must be neatly trimmed and dried for a few days before planting. If planted immediately after the cutting is made, and the weather is damp, it is possible that many will rot ; this is due to fungi having gained admittance on the freshly cut surface.

Planting.—After the land has been cleared and the rubbish burnt, it should be well ploughed or dug with a hoe to a depth of at least eighteen inches. There are many methods of planting ; these vary according to space between the rows and distance of the plants in each row. A method which has given good results provides ample space for each plant and also facilitates weeding and fruit picking, is to plant the suckers in double parallel rows, two feet apart in each row and 3 to 4 inches deep. A space of two feet is left between each row and five feet between the double rows. Care should be taken not to injure the leaves

when planting, and not to allow soil to enter the bud, as this might cause the sucker to rot or retard its growth. About 6,300 plants are required for one acre.

Wind Breaks.—When the fields are exposed, wind breaks should be established to shelter the plantation. Screens or hedges of " Acacia " (*Leucæna glauca*), "Herbe Conde " or " black sage" (*Cordia interrupta*) or any other suitable plant will serve the same useful purpose, if planted along the borders of each field.

Fertilizers.—There are several methods of applying fertilizers, the quantity and kind of fertilizers also vary according to the different countries where pineapples are grown.

The following is recommended to be applied per acre :—

	Kilos.
Whale flesh or dried blood	345
Sulphate of potash	285
Phosphatic guano	190

It is preferable not to apply the whole quantity at one time but to spread three equal applications over a certain period as follows : One-third about two months after planting, the second third four months later, and the remainder as soon as there are signs of flowering. If the soil on which the plantations have been made is good, the quantities of fertilizers to be applied may be reduced in proportion.

Cultivation.—The plantation should be kept free from weeds by hoeing the soil from time to time ; this will keep the weeds under control and aerate the soil at the same time. Care must be taken not to break the leaves, which are extremely brittle.

Crops.—It is estimated that a crop of from six to seven tons of fruit may easily be obtained per acre ; with good cultivation this yield may be considerably increased.

The fruits should be harvested when they are fully ripe ; if picked green, they may change their colour to yellow, but will not develop any sugar and will also have a poor flavour.

Insect Pests.—Fortunately there are few insect pests of the pineapple in Mauritius. Mealy bugs and scale insects sometimes attack plants if proper attention has not been taken to clean and disinfect planting material harbouring these pests. Kerosene emulsion will help in getting rid of them. No land infested with nematodes (eelworm) should be planted with pineapples.

Diseases.—Heart rot is a disease which causes the central part of the plant to decay; the rotten portion has a very offensive smell. Fortunately this disease is of rare occurrence in Mauritius, it has only been found in a few localities and it is advisable that every precaution should be taken to prevent its spread. The diseased plant should be cut and the cut surface then disinfected with a 5 per cent solution of creoline. All diseased shoots, after having been removed, should be carefully collected and burnt.—*The Tropical Agriculturist*, Vol. LXXXI, No. 1.

Tobacco Culture in Southern Rhodesia

By D. D. Brown, *Chief Tobacco Expert*

The operations of harvesting and curing are of supreme importance to the tobacco grower when viewed from the standpoint of financial return. The value of the tobacco is dependent upon quality, and unless proper care is exercised during the harvesting and curing stages, the financial returns may be seriously reduced through lack of quality in the cured leaf. Mistakes in either operation cannot be rectified when once made. The question of quality is of primary importance and it will become increasingly so with the growth of intensive competition with other tobacco-producing countries.

Ripening Stage.—The young tobacco plant, when growing vigorously, carries leaves of a deep green colour, which at this stage are soft and pliable. This intense green colour indicates a rich supply of nitrogenous constituents, which go to make up the vital or living parts of the leaf, and which are necessary for the building up of the food supply of the plant.

At about the time the leaves as a whole have reached their maximum power of elaborating the food supply, the flower head begins to develop. This food supply, consisting of starch and other similar substances, is carried from the leaf into the seed head to furnish the necessary food for the development of the seed. This accomplished, the leaves have completed their full task and they now pass into the period of gradual decay. In practice, however, the tobacco plant is "topped" so that the seeds are not allowed to develop. Making a last effort to reproduce itself, the plant then sends out secondary shoots or suckers, but these, too, are removed by the grower. Under these circumstances the food supply elaborated by the leaves is not translocated to other parts of the plant, but accumulates in the leaves themselves. The result is that the leaf increases both in size and in body. The accumulation of plant food in the leaf induces ripeness, and later, unless the leaves are harvested, gradual decay.

Should the plants make normal progress, the usual period required for the lower and middle leaves to ripen is about 90 days from the date of setting out in the field, the uppermost leaves ripening later.

Actual and personal experience is required before the grower is fully able to tell when the leaf is properly ripe, but the following explanation of the indications may prove of some assistance :—

The first indication of ripeness is a pronounced change in colour, provided this change is not caused by conditions other than maturity in the plant. In seasons of severe drought or extreme wet the leaves will often turn yellow before the plant is fully ripe. Plants affected by disease will also change colour prematurely ; root-gall is another common cause of this condition. The leaves of plants thus affected will not cure properly, and will lack the necessary quality.

The dark green colour of healthy, light-textured leaf changes by gradual degrees to a greenish-yellow as the leaf reaches maturity, whilst in the case of heavy-textured leaf the change to a yellow colouration may be confined to only small areas of the leaf-surface and causing the ripe leaf to appear with yellow flecks or spots. A sign of ripeness in very heavy tobacco is to be found in the way the tips of the leaves curl in towards the stalk of the plant. The accumulation of starch granules within the leaf cells causes the leaf to become brittle and roughened ; this change from being pliable and smooth to the touch is another indication of ripeness. Such leaf will crack when folded and pressed between finger and thumb.

Before being harvested the tobacco leaf must be suitably ripe, and it is essential that the greatest care be exercised in picking leaf which is suitably ripe for the method of curing to be employed.

The correct degrees of ripeness desirable for each method of curing are :—

Air curing—almost fully ripe leaf.
Sun curing—almost fully ripe leaf.
Flue curing—fully ripe leaf.
Fire curing—fully ripe leaf.

Many a promising crop of tobacco has been ruined in the harvesting and curing stages. A fairly common source of financial loss to tobacco growers is due to the practice of harvesting leaf which is unripe. Optimum results in the curing process depend upon certain factors, the correct stage of ripeness of leaf being one of the most important.

Harvesting.—Tobacco may be harvested by cutting down the whole plant or by the removal of individual leaves. The former method is generally employed in the case of sun-cured, air-cured and fire-cured

tobacco. It is an economical method as regards labour requirements, but has the drawback that all the leaves on the plant are not in the same state of ripeness when harvested.

Flue-cured tobacco is harvested by the single leaf method as this system has proved to be particularly suitable and renders easier the filling of the barn with leaf uniform in ripeness and texture. In order to harvest all the leaves produced, it is necessary to take from three to six pickings off the plant.

When harvesting by the whole plant method it is advisable to use a proper tobacco knife to split the stalk down the centre to within about six inches of ground level ; then, after holding the plant slightly down and away from the operator a slanting cut severs the stalk from the root. The plants are then allowed to wilt slightly, after which they are placed astride the curing stick ; one such stick will hold from six to ten plants depending upon their size. The sticks, when filled with their complement of plants, are next placed on a trolley to be conveyed to the barn or curing racks as the case may be. The tobacco should be carefully handled ; otherwise the leaves may become bruised and damaged.

In the single leaf system of harvesting, leaf of uniform ripeness is picked and then placed either in crates, baskets, ' machilas" or sleighs specially constructed for the purpose. A very suitable receptacle made and used by many tobacco growers is a contrivance manufactured from ordinary bush poles and hessian. The frame is made of poles (about 4 inches in diameter), the two top members extending about 12 inches beyond the end of the crate and serving as handles by which the receptacle is carried. For convenience in stowage the fixed handles might be replaced by detachable poles of the requisite dimensions passed under the top bars at either end and held in position by wire loops fixed at the four top corners. One set of such handles will serve for a number of these crates. A similar arrangement can also be applied to the iron crates now manufactured and sold by local firms.

Laths are placed across the bottom of the framework to prevent the hessian sagging when the crate is filled with leaf. The sides and ends are diagonally stayed with heavy guage galvanized wire. Hessian is sewn inside the framework to cover the bottom, sides and ends of the crate. A loose flap is also sewn along the top of one side, and is used to cover the tobacco to protect the leaf from sun-burn.

These crates are carried about the field, and, when filled, are loaded, one on top of another, on a wagon. Individual crates may also be placed on a sleigh, and drawn to and from the field in this fashion. The

containers holding the leaf are next carted to the stringing shed, which is situated in close proximity to the curing barns. Care should at all times be exercised, in the handling of the leaf, in order to prevent mechanical damage. Careless handling during the harvesting is responsible for much injury, due to the leaves becoming bruised and sun-burned, and no matter how well the curing process may be carried out, it is impossible to repair this damage.

In the stringing shed the containers are carefully emptied, the tobacco being placed on tables or in small heaps close to the natives tying the leaves on to the sticks. These sticks are supported at each end by a post let into the floor, and are some three feet high above floor level. The leaves are tied up in bunches of two to five leaves (according to the size of leaf).

Cotton string is used for tying the tobacco, one end of the string being securely tied to an end of the curing stick before the operator commences to deal with the leaf. The string is held in one hand, and with the other a bunch of leaves is placed in position close to the stick. The string is then wound round the leaves (not more than one inch from their "butts") one and one half turns before they are passed completely over and across the stick to complete the operation. In tying the leaves the string should always be wound round in the direction away from the operator. The next bunch of leaves is placed on the opposite side of the stick in order that the alternate bunches will balance the stick when filled.

When a sufficient number of bunches has been placed on the stick (usually 32 bunches) the free end of the string is wound round and tied to the end of the stick, which is then ready for hanging in the curing barn.

In cured tobacco the colour, texture and quality of the leaf are the important features. When harvested before the proper time the leaf will retain a green colour and if picked when over-ripe the colour will be uneven and blotchy, besides being harsh and lacking in quality. Leaf which cures out a deep green colour is of little or no commercial value, so if an error is to be made, it is better to err on the side of picking over-ripe leaf rather than green leaf, for over-ripe leaf has some commercial value when offered for sale.

For flue-cured tobacco it is essential to fill each curing barn with leaf in the same state of ripeness, for when tobacco in varying stages of ripeness is placed in the barn, all of the leaf will not cure at the same rate, and will, therefore, not be uniform in colour when cured. The leaf filled into each barn should also be of uniform texture for the same

reason. Close personal attention to these details is required from the grower if a frequent cause of serious loss is to be avoided.

Curing.—It is estimated that approximately 80 per cent of the total weight of tobacco as harvested is comprised of water.

In the curing process this moisture is gradually expelled from the tissue of the leaf, and certain chemical and physiological changes take place which bring about the formation of those desirable qualities in properly cured tobacco.

During curing the leaf is subjected to gradual starvation, regulated by certain conditions. If by means of excessive heat or protoplasmic poisons the cells are prematurely killed, the leaf will not be properly cured and will consequently lack in essential qualities. The principal factors by which the curing is controlled are heat and moisture. There are four methods of curing tobacco in general use, *viz.*, air-curing, sun-curing, fire-curing and flue-curing, and the conditions for one method may not be applicable to another.

The purpose for which the tobacco is to be used, as well as the climatic and soil conditions under which it has been grown, largely determine the method of curing. The abbreviated list given below indicates the several methods of curing, and the types of tobacco cured by each method :—

Air-cured—	
Cigar tobacco Burley Stemming Transvaal tobacco Australian tobacco	Cigars, pipe mixtures, chewing, snuff and cigarettes.
Sun-cured—	
Turkish Maryland Virginia Rhodesian Indian	Cigarettes, smoking and chewing.
Fire-cured—	
Virginia dark Kentucky dark Tennessee dark Nyasaland dark Rhodesian dark Canadian dark Uganda dark	Chewing, smoking, snuff and cheap cigars.

Flue-cured—

Virginia bright	Cigarettes, pipe mixtures, chewing and snuff.
Carolina bright	
Nyasaland bright	
Rhodesian bright	
Canadian bright	
Indian bright	
Australian bright	
Transvaal bright	

Air-Curing.—This method of curing is the simplest, and is very extensively employed; a great part of the world's tobacco supply is thus cured. Air-curing is a natural process for the tobacco is harvested and placed in the barns to be cured by natural atmospheric conditions. The results obtained are dependent upon climatic conditions, and if the conditions are ideal, and proper care has been taken in harvesting, the tobacco will cure out well.

In order to overcome the effects of unfavourable weather conditions on the curing, growers have of recent years introduced artificial means (heat and moisture), which somewhat modify the process.

When an excessively dry and hot spell sets in immediately after the tobacco is placed in the barn, the curing is rendered difficult and unsatisfactory, as the leaf may be killed prematurely thus causing poor colour and a lack of desirable qualities. When wet weather prevails, heavy loss may be caused through "pole-sweat", and the colour of the leaf may be adversely affected. The ideal climatic conditions for air-cured tobacco are obtained when the weather is calm and clear, with a shade temperature of from 80° to 90° F., and a moderately dry atmosphere. When the above conditions obtain the moisture given off from the leaf is readily absorbed by the atmosphere, thereby lessening the chance of oxidation taking place. Under ideal conditions the bulk of the leaf should cure out a moderately bright colour.

The occurrence of wet weather during the final stages of curing and before the tobacco is removed from the curing shed, will cause the leaf to turn red. Normally the time required for air-curing is from between six weeks to twelve weeks, depending upon the nature of the tobacco and the climatic conditions prevailing during the curing process. When the single leaf method of harvesting is employed, the curing will take less time than would be required in the case of curing the whole plant.

The purpose for which the tobacco is to be used in a great measure determines what the desirable colour of the leaf should be. For cigarette purposes the leaf should be lemon yellow to light orange in colour, whilst

leaf for pipe mixtures, plugs and twist will range from light red to dark brown. In the case of cigar tobacco the most desirable colours are brown and olive shades.

Normally, all leaf turns to yellow colour before it begins to dry out. If it dries before yellowing, it will remain a green colour, and consequently be of little or no commercial value. When the drying is delayed too long after the yellow colouration appears, oxidation takes place, and the leaf will turn a reddish or brownish shade.

When filling the curing shed the sticks of tobacco are hung up on tiers, starting from the topmost tier and working down to the lowest. Much damage may be caused through placing sticks, holding the entire tobacco plant, in the wrong order. Any one tier should not be filled before another is commenced. The correct procedure is first to place one stick on the highest tier. The following stick is placed on the next tier down, with the butts of the tobacco plants just touching the tips of the plants suspended from the stick above. The next stick should then be hung on the third tier down, and placed in similar relation to the stick above, as indicated for the first and second sticks placed in the barn. This order of filling is continued until the bottom stick has been suitably placed on the last tier, when the same order is observed by commencing again at the top and working downwards as before. This is continued until one section or "room" is filled. Each section is completed in proper sequence until the barn is fully packed. The filling of a barn should be commenced at a point furthest away from the door, leaving that section by the door until last.

At first the tobacco sticks are placed along each tier at intervals, which allow the plants to touch, but they must not be in too close contact. The usual spacing allowed is about six to eight inches, depending upon the length and girth of the plants. Later on, when the tobacco is well yellowed in the barn, the spacing between each stick may be increased in order to hasten the drying process. During excessively dry weather the sticks of tobacco should be kept closer in order to prevent the leaf drying out too rapidly, and to enable it to turn a suitable yellow colour.

The atmospheric conditions in the barn should be controlled so that the relative humidity is fairly high during the wilting process, the wet bulb of the hygrometer registering between $2\frac{1}{2}$ degrees to 3 degrees below the dry bulb. If the difference in reading between the wet and the dry bulbs be greater than 3 degrees more moisture should be introduced into the barn. On the other hand, should the difference be less than

2½ degrees, the humidity must be reduced by ventilation or by heating. The temperature of the barn should be maintained at from 70 to 75°F. during the wilting process. When the tobacco has changed to a pale greenish-yellow tinge the temperature should be increased to 80°F. and then to 90°F. The relative humidity should be decreased in order to allow the leaf to commence drying. Care must be exercised at this critical stage in the curing, otherwise the tobacco may become spoiled either through drying too quickly and remaining green or through excessive moisture and delayed drying causing sponging and, in extreme cases, pole-burn.

After the leaf has yellowed the rate of drying should be gradually increased by use of ventilators. In barns fitted with flues the curing may be hastened by lighting the fires. Another method of curing is possible by removing partially cured tobacco from the air-curing barn and completing the curing process by the sun-cured method.

As an alternative a combination of the air-cured and sun-cured methods may be adopted. The tobacco is first placed in the air-curing barn and is wilted and yellowed in the usual manner, after which it is removed from the barn and the curing process is completed by the sun-cured method. The partially cured tobacco is conveyed to the curing racks, where it is exposed to the direct rays of the sun until the leaf is thoroughly dried out.

Speaking generally, climatic conditions during the early part of the season are not conducive to good results, and if air-curing were to be properly developed in Southern Rhodesia it would be necessary to utilize suitable air-curing barns. In other countries where this method of curing is practised the barns are both elaborate and costly. The erection of grass sheds in which the tobacco is more or less exposed to the elements cannot be recommended and disappointing results may be expected.

Sun-Curing.—Sun-curing is similar to air-curing in that no artificial heat is employed. In other features, however, it differs. In this method the rate of curing is hastened by exposing the leaf to the direct rays of the sun, whilst in air-curing the curing is primarily regulated by atmospheric conditions.

In addition to a packing shed, bulking shed and conditioning pit (all of which are necessary on any farm where tobacco is produced), a wilting room and curing racks are necessary equipments.

The wilting room is used for yellowing the leaf before the tobacco is placed out on the drying racks. A suitable room is fairly dark and

cool, and besides being used for wilting, may also serve for conditioning the cured leaf.

The packing shed should be furnished with roof lights, as this means of lighting is more satisfactory than when side windows only are employed. Grading of the leaf can be done in this building, besides the baling of the leaf after grading.

The bulking shed requires no elaborate lighting, but should only have sufficient light to enable the bulking operations to be properly carried out.

The drying racks are made from native timber or native timber posts and plain heavy guage galvanized wire. In the former case, posts are set into the ground, and the light sticks, forming the rails, are attached to them; while in the latter case, the wire forms the rails in place of the light sticks. The conditioning pit is used for softening the cured leaf.

The dry leaf is placed in the pit, and after hanging there for a time, the web of the leaf will have absorbed sufficient moisture to make it pliable and fit for handling without breakage. A suitable pit is made by digging a rectangular hole in the ground and roofing it over with grass or reeds and earth. Where grass is employed, a pitched roof should be built. The site selected for the conditioning pit should be one where water will not seep through to such an extent that the pit will be flooded.

In sun-curing, the whole plant is usually harvested, but the single leaf method may also be employed, especially where the leaf is to receive the final stages of curing in a flue-curing barn. The usual practice followed in sun-curing is to harvest the tobacco just before it is fully ripe. The plants, after being placed on sticks, are put into the wilting room until the leaf turns a greenish yellow. When the leaf is properly yellowed it is removed from the wilting room placed on the drying racks, where it is exposed to the direct rays of the sun until both the web and mid-rib are thoroughly dried out. The time usually required for sun-curing is from four to six weeks. Some means of covering the tobacco on the curing racks is required for use during the nights, and in the event of rain, during the day. The tobacco may be covered with bucksails, hessian or grass mats. After the tobacco has been on the racks from four to six weeks it should be ready for removal to the conditioning pit. The removal of the cured tobacco from the racks should be carried out, if possible, when there is a certain amount of moisture in the atmosphere either during misty weather or nearly in the morning before the heat of the sun dissipates the moisture absorbed by the leaf overnight.

A great deal of damage may be caused through handling the cured leaf when it is in a brittle condition. It is usual, therefore, to wait until

the leaf absorbs sufficient moisture from the atmosphere, when climatic conditions are favourable, before removing the tobacco from the curing racks.

Where it is absolutely essential to have the tobacco removed from the racks within a certain time, growers may sometimes resort to the expedient of taking down the sticks from the racks about sundown, and placing them flat down on the grass, where, by leaving the tobacco fully exposed to the dew overnight, the leaf will become soft enough for handling by sunrise the next morning. Should the dews be heavy, the tobacco will lose colour through becoming wet, so this practice is not to be recommended, except in cases where it is imperative to have the tobacco removed from the curing racks within a certain time.

In order to assist in the production of good quality sun-cured leaf, the crop should not be planted too early in the season, but it should be transplanted so that it will be ready for harvesting about the time when the rains normally cease.

The sun-curing method can be recommended where soil and climatic conditions are suitable for the production only of a heavy type of tobacco.

Plants producing leaf too heavy for flue-curing satisfactorily may be found in many fields of flue-curing tobacco, especially round ant-heaps. The leaf of such plants should first be wilted, and may then be sun-cured until the leaf is dry. It should then be placed in the flue barn, and the mid-rib dried out.

Sun-cured tobacco differs somewhat from air-cured leaf, and possesses certain desirable qualities. It is usually lighter and more uniform in colour, and is sweeter and more aromatic. This type of leaf is used for chewing and for pipe mixtures.

Fire-Curing.—This method of curing tobacco calls for the use of fire during the curing process. Heat is applied by means of open fires placed in trenches directly beneath the tobacco. The smoke from the burning wood imparts a creosotic flavour and peculiar aroma, besides improving the keeping qualities of the cured leaf.

The production of this type of tobacco can only be recommended where soil and climatic conditions are suitable for the production of a heavy type of leaf. The quality of the tobacco should be of a high standard.

For fire-curing suitable barns are required. Plans and specifications of such barns are contained in Bulletin No. 617.

Tobacco to be cured by this method should be heavy bodied, smooth textured, with large oily leaf rich in nitrogenous constituents. The soil for the production of tobacco suitable for fire-curing should contain high

percentages of humus, clay and silt, and be naturally fertile and well drained. Liberal applications of kraal manure or fertilizers should be used in order to further increase the growth of the plant. When fertilizers are used, the nitrogen contained therein should be mostly derived from an organic source, such as fish meal. The plants are topped low in order that only large leaf is produced.

The plant is not harvested until it has become fully ripe, the whole plant method being practised as described under "harvesting". After the tobacco has been placed on the sticks and been allowed to wilt slightly, it is carted to the barn and placed on the tiers. In filling the barn the proper procedure is to place the first stick of tobacco on the top tier, then the next stick on the second tier, and so on, until the bottom tier is reached. This procedure is repeated until that room or section of the barn is completely filled with tobacco sticks. The sticks are placed at six to nine inch intervals along the tiers, care being taken not to crush the tobacco leaves between the sticks, or to damage the tobacco by placing the next stick directly beneath those plants hanging on the tier above. After the tobacco has been hanging in the barn for a period of from four to six days, the leaf should be yellow, and when the tobacco has reached this stage, small fires are lighted in the trenches dug in the floor of the curing barn, and the temperature of the barn is gradually increased to about 100°F. This temperature is maintained until the tip and edges of the leaf begin to curl and turn brown, when the fires are put out and the barn allowed to cool down; this will allow the sap to become uniformly distributed through the leaf, and the brownish parts of the leaf become pliable. The fires are then restarted, and temperature raised to a few degrees higher than during the preceding stage.

When the brown colour begins to spread from the edges of the leaf towards the mid-rib, and the brown coloured part of the leaf becomes brittle, the fires are again removed to allow the barn to cool down and the sap to spread. This process is repeated, and as the curing progresses the temperatures are increased each time after the fires are restarted.

It is seldom advisable to raise the temperature higher than 125°F. The cured leaf should be of good size and body and a uniform dark brown colour.

The desirable qualities of the cured leaf may be seriously affected through being subjected to excessive quantities of smoke, which may leave heavy deposits on the leaf and blacken the tobacco to a great degree. Certain wood gives off an unpleasant odour when burned, and should this be taken on by the tobacco, it is undesirable.

The fuel used for burning in fire-curing barns should be selected from hard woods which do not create any unpleasant smell whilst burning.

After the curing is completed, the tobacco is brought into condition in a similar manner to that already described under air and sun-curing. The leaves are then stripped from the stalk, graded according to size and colour, tied up into hands, and bulked preparatory to baling.

The time taken for fire-curing is between two and three weeks, according to the size of the tobacco and climatic conditions. Should the curing be carried on at too fast a rate, the quality of the leaf will be of low grade and little commercial value.

Flue-Curing.—This is the method generally used by the growers of tobacco in Southern Rhodesia, and for which the majority of the tobacco produced is most suited. The rate of curing in this method depends upon the use of artificial heat, and the process calls for specially designed barns. Specifications and plans of suitable flue-curing barns have previously been published in this Journal, and reprinted as Bulletins Nos. 605 and 661.

Heat is generated in the furnaces by means of wood fires, and flues radiate this heat into the barn. Coal may also be used in properly constructed furnaces.

Flue-curing is the most modern method of curing tobacco, and requires constant and careful attention to all details connected with it. The skill and care exercised during the curing have a direct influence on the value of the tobacco produced. The colour most sought after is a clear lemon yellow, and this leaf brings the highest price. Varied colours are found in every barn cured, and green is the colour least desired. Care in picking will considerably reduce the quantity of green-coloured leaf. Leaf which gives the best results is fine textured and silky. *There are many formulas advanced for this method of curing, and any one may be correct under certain conditions, but they cannot all be correct at one and the same time.* The type of leaf and the climatic conditions obtaining during the process will largely regulate the rate of curing. For instance, heavy leaf will be longer in curing than light leaf, and leaf which is yellow when picked will cure faster than green-coloured leaf. Higher temperatures are required in wet weather than in dry weather, and lower temperatures are required in cool weather than in warm weather.

The state of the atmosphere outside the barn has also to be considered in regulating the ventilation of the barn during the time the tobacco is being cured. A dry outside atmosphere calls for reduced ventilation through bottom ventilators, and the top ventilation should also be

reduced to a minimum, so that the leaf will not dry out too rapidly and possess an undesirable green colour.

During wet weather the bottom ventilation is reduced and top ventilation is increased, in order that the moisture-laden air may be driven out of the barn.

During excessively wet spells, and when the leaf is heavy bodied and contains a good deal of moisture, it may sometimes be advisable to open slightly the top ventilators, when the temperature in the barn reaches 105-110°F., and by this means reduce the amount of "sponging" which often takes place when the barn is kept closed, until a temperature of 115° (the temperature to be reached before ventilation is recommended under normal conditions) is registered within the barn.

In the event of conditions requiring the above system of ventilation, the top ventilators are at first opened to a very small degree, and the opening gradually increased in order to drive off the excess moisture from inside the barn. The bottom ventilators should be kept closed at this stage of the curing, or only a very limited amount of ventilation allowed as excessive ventilation through the bottom vents would defeat the object in view by introducing a fresh stream of moisture-laden air into the barn.

In flue-curing there are three distinct stages through which the leaf must pass, namely, yellowing the leaf, fixing the colour, and drying the leaf and mid-rib. In Rhodesia the single-leaf method of harvesting is used, but in other countries, where the whole plant is put into the flue-curing barn, a fourth stage is required, namely, the killing of the stalk.

Yellowing Stage.— The barn is filled with leaf of the same texture and ripeness. The filling of the barn should be accomplished in one day, so as to assist the tobacco to cure evenly. A thermometer and hygrometer are suspended from the bottom tier in the middle of the barn; a suitable thermometer should be graduated in single degrees up to 170°F. The hygrometer has both a wet and dry bulb; the latter should have the water receptacle filled with water when placed in the barn. As soon as the barn has been filled the door and ventilators are closed to prevent the escape of moisture. Small fires are then made in each furnace, and these are increased in size until the temperature of the barn is raised to 90°F.

In the early stages of curing, a low temperature is essential until the leaf yellows; a high temperature at this stage would ruin the tobacco. The temperature is therefore kept at 90°F. until the leaf starts to yellow at the tips and round the edges. This having occurred the temperature is gradually raised to 95°F. and this temperature maintained until the

yellow colour begins to spread in towards the mid-rib of the leaf. The temperature is then increased gradually to 100°F., and maintained at this temperature until the yellow colour is more pronounced.

During this time, the atmosphere of the barn should be saturated to prevent the leaf from drying out. Enough moisture must be kept in the barn to give a reading of 3° or 4° difference between the wet and dry bulbs of the hygrometer; the wet bulb should only register 3° or 4° below the temperature recorded on the dry bulb. When the wet bulb registers more than 4° below the dry bulb, the indication is that the atmosphere within the barn is becoming too dry, and should this be the case, it will be necessary to introduce more moisture into the barn by pouring water on the floor and lower walls. In place of water, low-pressure steam may be introduced until the required degree of humidity has been attained.

When the leaf begins to show more yellow in colour, the temperature is increased to 110°F., and this heat maintained until the leaf is yellow, with only a slight greenish tinge. The temperature is then gradually raised to 115°F., and held there until the proper yellow colour is obtained. Between the temperatures of 100°F. to 115°F., the amount of moisture in the atmosphere of the barn is gradually reduced until the wet bulb registers from 6—7° below the dry bulb. Maintaining the correct amount of moisture in the barn during this stage is very important.

Fixing the Colour.—This is the most critical stage in the curing, and it is here that many a barn of good tobacco becomes spoiled. The greatest care in the manipulation of the barn is required at this period of curing. The leaf will turn to reddish brown colour if the atmosphere of the barn is too humid, or if the ventilation is inadequate and the temperature is not increased fast enough. This discolouration of the leaf is known as "sponging" and is caused through moisture collecting on the surface of the leaf. Another discolouration is caused through the cells of the leaf being prematurely killed, preventing the necessary chemical changes taking place. This happens when the ventilation is excessive and the temperature is increased too rapidly; the leaf in this case has a dark greenish red or blackish colouration. Sponged tobacco is of more value than green or blotched leaf, but the grower should try to eliminate all three classes of leaf.

The main object in fixing the colour is to try and prevent any further change in the colouration of the leaf after the yellowing stage is passed. The barn should be so managed that the moisture is carried off through the ventilators as fast as it is given off by the leaf. The temperature

is regulated in such a fashion that the colour will be normally fixed in 15 to 18 hours. The top and bottom ventilators are slightly opened when the leaf is of the proper yellow colour, and the temperature registers 115°F. When the ventilators are opened, the fire should be slightly increased to prevent the temperature of the barn falling below 115°. The ventilation is next slightly increased and the temperature is still maintained at 115° until the tips of the leaves begin to curl upwards. The next step is to increase the temperature to 120°F., and hold it there until the leaf begins to curl in towards the mid-rib. The leaf is now drying and the temperature is further increased to 125°F., this temperature being maintained until the web of the leaf is about to dry.

Drying the Leaf.—To complete the curing it is necessary completely to dry the leaf, and this is accomplished by raising the temperature from 125°F. to 130°F. in two hours' time, after the web of the leaf appears to be dry. The temperature of 130°F. should be maintained for about four hours, then raised to 135°F. in one hour, and held there for about four hours, when the web of the leaf should be thoroughly dried out. Ventilation is next reduced, the temperature increased hourly by about 5° until a temperature of 160°F. is maintained until the mid-ribs of the leaves are dry and brittle. A temperature in excess of 160°F. is not recommended, nor should it be necessary except where the whole plant method of harvesting is employed, in which case the maximum is 180°F.

By using temperatures in excess of 160°F., growers cause a decline in the quality of their tobacco. High temperatures render the leaf very brittle, and it lacks the soft silky feel necessary in high grade tobacco. The colour of the leaf is also impaired and rendered dull, instead of having a lively appearance. Normally, the time required for curing tobacco in flue-curing barns is between four and six days.

It must be clearly understood that the above temperatures are given only as a guide, and while being correct under certain conditions they are not expected to be suited to the curing of every barn of tobacco during each and every season.

The grower will find the above guide useful in deciding how the curing is proceeding, and by modifying the temperatures, moisture and ventilation, will be enabled to arrange the rate of curing to suit the type of leaf in the barn and the climatic conditions prevailing during the period of the process.

Handling the Cured Leaf.—The characteristics of the cured tobacco are either improved or spoiled in the subsequent handling of the leaf. It is not proposed here to discuss the handling of tobacco after it has been cured, as this phase of tobacco culture has already been fully dealt

with in Bulletin No. 641, issued by authority of the Minister of Agriculture and Lands.

In conclusion, it may be stated that to become thoroughly proficient a tobacco grower needs to gain experience through the actual handling of the crop, for there are certain details in connection with the growing, harvesting, curing and handling of tobacco which cannot be fully grasped through perusal of reading matter alone.

SUMMARY.

1. The harvesting of tobacco, whatever be the method adopted for curing, is very important, and has a large influence on the value of the cured product.

2. Get to know when a leaf is ripe, and harvest leaf which is suitably ripe for the process by which it is to be cured.

3. Uniformity in harvesting takes for uniformity in curing.

4. Green tobacco is of low value ; take every precaution to produce the absolute minimum of undesirable leaf.

5. Harvesting of tobacco is facilitated by having adequate barn accommodation.

6. The tobacco should be carefully handled during the harvesting otherwise damage may result for which you have to pay.

7. The curing of tobacco is a scientific process, and requires to be studied as such.

8. Buildings suitable for the purpose are an aid to satisfactory curing.

9. Do not overcrowed the barn ; it costs money when the leaf is damaged through being too tightly packed for curing.

10. Have your buildings and plant for curing put in working order before the crop is due for harvesting.

11. Provide for adequate supervision throughout the harvesting and curing of the crop.

12. Endeavour not to grow more tobacco than can properly be accommodated in your buildings ; excessive quantities of tobacco in relation to housing accommodation usually lead to the production of a lower grade leaf.

13. Every effort should be made to produce quality rather than quantity.

14. Make provision for future fuel requirements by planting trees to replace the indigenous timber already cleared off the land.—*Tropical Agriculturist*, Vol. LXXX, No. 5.

PRESS COMMUNIQUE.

On the 7th June 1933 it was announced that the Imperial Council of Agricultural Research would award each year one gold and two silver medals for improvements of distinct merit in the science and art of Agriculture and Animal Husbandry of an all-India importance. The programme of award of prizes for five years from 1934 was divided into the following five groups: —

1. Veterinary Scientific instruments and appliances.
2. Dairying and care of animals.
3. Field implements and appliances.
4. Machinery for preparing crops for market, for food or for storage.
5. Water lifts.

Entries for the award in 1934 of prizes for the first group were accordingly invited last year. Applications are now invited for the award of prizes during 1935 for the second group, *viz.*, Dairying and care of animals.

The following procedure will govern the submission of entries :

Entries will be submitted in the first instance to the Provincial Agricultural Research Committees which will forward to the Council those which they consider the most suitable and also a description of rejected entries.

All the entries for the second group of award should reach the Secretary, Imperial Council of Agricultural Research, through the proper channel by 1st December 1934. Necessary forms and conditions of prize can be obtained from the Secretary. Imperial Council of Agricultural Research, Simla/New Delhi.

(Sd.).....

Secretary, Imperial Council of Agricultural Research.

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